

# RESEARCH STATUS OF WASTE COLLECTION AND TREATMENT FROM AGRICULTURAL PRODUCTION ACTIVITIES ALONG MA AND CHU RIVERS IN THANH HOA PROVINCE

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**Abstract:** *Ma and Chu river basins have tributaries across many districts and cities of Thanh Hoa province, such as Thanh Hoa city, Thieu Hoa, Dong Son, Quang Xuong district; four coastal districts: Hau Loc, Nga Son, Sam Son, Hoang Hoa and nine mountainous and midland districts: Quan Son, Quan Hoa, Muong Lat, Ba Thuoc, Ngoc Lac, Thuong Xuan, Vinh Loc and Cam Thuy, Tho Xuan, Yen Dinh. This research has mainly investigated, surveyed and assessed the status of agricultural waste collection and treatment from agricultural production activities in 13 districts and cities, which have significant impact on water quality in Ma and Chu rivers. These research results could be used as practical basics to propose the measures for environmental protection of the basin.*

**Keywords:** *Ma river, Chu river, waste treatment.*

## 1. Introduction

Ma river has a total length of 512km, in which 270km flows through districts of Thanh Hoa province including: Muong Lat, Quan Hoa, Ba Thuoc, Cam Thuy, Vinh Loc, Yen Dinh, Thieu Hoa, Thanh Hoa, Hoang Hoa, Quang Xuong, Sam Son... and then enters the sea at three river estuaries: Lach Hoi, Lach Truong and Lach Sung [1]. Chu river is the largest branch of the Ma river system, derived from Sam Nua (Laos) at an altitude of 1,100 meters, running through Vietnam in Thuong Xuan district, Tho Xuan, Thieu Hoa and then joining Ma river at the Giang confluence [2].

With the large scale of catchment area, Ma river basin is now a region with rapid developing economy of the country, there are many establishments, enterprises and households on basin basing on natural resources and their benefits. On this basin there are

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activities to develop the hydropower, mining, farming, fishing, utilize water resources for daily life, agricultural production and manufacturing facilities, sales close localities, households... bring a prosperous life for the people living along the banks of the Ma river in particular and people in Thanh Hoa province in general. The river also supplies water for two major metropolitan cities of Thanh Hoa and Sam Son. However, agricultural production in the province has generated a relatively large amount of waste with no proper collection and treatment, causing water pollution. This situation has a relative negative impact on the lives and health of people, biodiversity, and fishery production. Therefore, the investigation and assessment of the current status of agricultural waste collection and treatment to assess water pollution in Ma, Chu river is very important and imperative.

## **2. Objectives and methods**

### **2.1. Objectives**

The research investigated, surveyed, assessed the status of agricultural waste collection and treatment in 13 districts where have sources of waste generation and significant impact on water quality in Ma and Chu rivers, including: Quan Hoa, Ba Thuoc, Quan Son, Cam Thuy, Thuong Xuan, Tho Xuan, Vinh Loc, Yen Dinh, Thieu Hoa, Hoang Hoa, Quang Xuong, and cities: Thanh Hoa, and Sam Son.

### **2.2. General procedures**

The research has applied the approach and used methods for analysis and assessment of the current status in wasted collection and treatment from agricultural activities along Ma and Chu rivers:

*Practical, systematic and comprehensive approach:* In fact, due to the economic - social development demands - water pollution in Ma and Chu rivers are rising worse. Therefore, there is a need to implement the project using practical approach.

*Methods of sociological surveys:* Through interviewing techniques, how to ask questions (according to the content of prepared questions) to find out the source and type of waste generated from agricultural activities along two Ma and Chu rivers, and applied treatment technology.

*Methods of synthesizing data:* Based on the survey data, the study has compiled the survey data based on software Excel.

*Expert consultation method:* Consulted experts in the relevant fields after completion.

The method of collecting, preserving and analyzing samples carried out under the guidance of national or corresponding international standards.

*Method of synthetic analysis and comparison:* Compared analytical results with national standards and regulations to assessed the current status of waste collection, management and treatment, along with the current status of water quality in Ma and Chu rivers.

### 3. Results and discussion

#### 3.1. Current status of agricultural waste water collection and treatment

In 2015, the survey showed that most of research districts and cities had no treatment measures for wastewater from agricultural activities after each crop or season. Wastewater was discharged directly into the irrigation systems with various other sources as shown in the Table 1.

**Table 1.** Receiving sources of agricultural wastewater

No	Locations	No of participants	Receiving sources		
			Water plants	Canal and infield	Directly discharge to Ma, Chu river
1	Yen Dinh	10	3	3	4
2	Cam Thuy	15	4	4	7
3	Vinh Loc	17	7	3	7
4	Hau Loc	2	0	1	1
5	Thanh Hoa city	13	2	1	10
6	Quan Hoa	3	0	0	3
7	Thieu Hoa	16	8	3	5
8	Thuong Xuan	6	2	2	2
9	Tho Xuan	2	1	0	1
10	Hoang Hoa	11	9	2	0
11	Ba Thuoc	1	0	0	1
12	Quang Xuong	1	0	0	1
13	Sam Son	3	0	3	0
Total		100	36	22	42
Scale		100%	36%	22%	42%

According to the survey, 42% local residents directly discharged untreated wastewater into Ma, Chu river; 36% reused for watering plants and 22% discharged canals and infield. Results of water quality analysis in Ma, Chu river at 10 water discharge points, sewer and drainage from agricultural fields showed most of the water quality in these areas were contaminated, as follows:

Water quality at the water outfall from upstream areas, in the river confluence between Ma and Lo rivers at Hoi Xuan commune, Quan Hoa district, was contaminated with BOD<sub>5</sub>, NO<sub>2</sub> exceeding QCVN 40: 2011/BTNMT 1,046 and 3.5 times respectively.

Water quality at the water outfall from upstream areas, in the river confluence between Ma and Am river at Giao An commune, Lang Chanh district, was contaminated with BOD<sub>5</sub>, NO<sub>2</sub> exceeding QCVN 40: 2011/BTNMT 1.05 and 3.7 times respectively.

Water quality in the drainage at Muc Son, Lam Son, Tho Xuan district, discharging to Chu river was contaminated with TSS exceeding 2.33 times; COD exceeding 6.04 times; BOD<sub>5</sub> exceeding 8.96 times; NO<sub>2</sub> exceeding 10.5 times; Amoni exceeding 7.8 times compared to QCVN 40: 2011/BTNMT.

Water quality in the drainage at Xuan Lai, Tho Xuan district, discharging to Chu river was contaminated with TSS exceeding 2.18 times; COD exceeding 4.04 times; BOD<sub>5</sub> exceeding 7.5 times; NO<sub>2</sub> exceeding 18.5 times; Phospho exceeding 2.5 times compared to QCVN 40: 2011/BTNMT.

Water quality in the drainage at Cam Phong, Cam Thuy district, discharging to Chu river was contaminated with TSS exceeding 1.86 times; COD exceeding 4.1 times; BOD<sub>5</sub> exceeding 5.58 times; NO<sub>2</sub> exceeding 18.6 times; Amoni exceeding 4.15 times compared to QCVN 40: 2011/BTNMT.

Water quality in the drainage at Yen Truong, Yen Dinh district, discharging to Ma river was contaminated with TSS exceeding 2.09 times; COD exceeding 4.35 times; BOD<sub>5</sub> exceeding 5.11 times; NO<sub>2</sub> exceeding 29 times; Amoni exceeding 5.3; Clorua exceeded 10 times; Endrin exceeding 3.33 times; DDT exceeding 20 times; Endosunphat exceeding 4 times; Chlordan and Heptachlor exceeding 2 times; Phospho exceeding 1.95 times; Malation exceeding 1.12 times compared to QCVN 40: 2011/BTNMT.

Water quality in the drainage at Xu Nhan, Thieu Duy, Thieu Hoa District, discharging to Chu river was contaminated with TSS exceeding 2.09 times; COD exceeding 4.42 times; BOD<sub>5</sub> exceeding 7.5 times; NO<sub>2</sub> exceeding 29 times; Amoni exceeding 5.1; Phospho exceeding 1.7 times; Malation exceeding 10,625 times compared to QCVN 40: 2011/BTNMT.

Water quality in the drainage at (Phu Quang dyke), Hoang Quang, Thanh Hoa city, was contaminated with TSS exceeding 2.05 times; COD exceeding 5.67 times; BOD<sub>5</sub> exceeding 11.33 times; NO<sub>2</sub> exceeding 20.5 times; Amoni exceeding 5.7; Phospho exceeding 1.05 times compared to QCVN 40: 2011/BTNMT.

Water quality in the drainage (Yen Lac dyke) at Vinh Ninh, Vinh Loc district, discharging to Ma river, was contaminated with TSS exceeding 2.05 times; COD exceeding 6.58 times; BOD<sub>5</sub> exceeding 9.26 times; NO<sub>2</sub> exceeding 27.5 times; Amoni exceeding 8.25; Clorua exceeding 15 times; Endrin exceeding 5 times; DDT exceeding 30 times; Endosunphat exceeding 6 times; Chlordan and Heptachlor exceeding 3 times; Phospho exceeding 2.05 times; Malation exceeding 1.28 times; Coliform exceeding 1.18 times compared to QCVN 40: 2011/BTNMT.

Water quality in the drainage at Quang Cu, Sam Son, discharging to Ma river, was contaminated with TSS exceeding 2.36 times; COD exceeding 7.66 times; BOD<sub>5</sub> exceeding 11.75 times; NO<sub>2</sub> exceeding 26 times; Amoni exceeding 9.15; Phospho exceeding 1.25 times; Coliform exceeding 1.06 times compared to QCVN 40: 2011/BTNMT.

### 3.2. Current status of agricultural solid waste collection and treatment

Besides, the problem of collecting, processing packaging, bottles containing plant protection chemicals and fertilizers was not strictly controlled, affecting water quality in the infield canals. The survey of environment protection for agricultural production along the Ma and Chu river banks with the participation of environmental officers in the province is displayed in the Table 2.

*Table 2. Measures of rural waste disposal*

District	No of questionnaire	Waste collection available	Number of landfills	Type of landfill		Plant protection chemical products' trash management		
				Spontaneous	Planning	Collect on 1 position	Treated along with sanitary waste	No treatment
Yen Dinh	10	6	10	2	8	6	2	2
Cam Thuy	15	7	9	6	3	2	5	8
Vinh Loc	17	14	17	6	11	5	12	0
Hau Loc	2	2	2	0	2	0	2	0
Thanh Hoa	13	10	13	1	12	4	5	4
Quan Hoa	3	0	3	3	0	0	1	2
Thieu Hoa	16	11	16	5	11	7	4	5
Thuong Xuan	6	4	6	4	2	0	2	4
Tho Xuan	2	2	2	0	2	2	0	0
Quang Xuong	1	1	1	0	1	0	1	0
Ba Thuoc	1	1	1	0	1	1	0	0
Hoang Hoa	11	9	11	4	7	7	0	4
Sam Son	3	3	1	0	1	1	1	1
Total	100	70	92	31	61	35	35	30
Scale (%)		70	92	34.83	65.17	35	35	30

Collecting waste generated from plant protection chemical products: 30% local authorities had no treatment, 35% conducted collection in one position, and 35% had collection and treatment along with sanitary waste.

For the issue of waste collection and treatment: 70% local authorities collected sanitary waste, 92% having dedicated landfills, in which 34.83% landfills were planned by authorities (highest scales at Vinh Loc, Thieu Hoa, and Thanh Hoa city); spontaneous landfills accounted for 34.83%.

For the waste, by-products from cultivation, harvest agricultural products such as: rice straw, rice hulls, corn, bagasse... local residents have many different treatment methods. The most popular method was to use as fuel. Normally, 80% of generated waste was utilized as fuel, the remaining 20% was treated into fertilizer for crops. Particularly in Tho Xuan district, Lam Son Sugar Company has invested to build a factory producing electricity from bagasse with a total capacity of 12.5 MW. The plant operates on the basis of utilizing bagasse to produce electricity, air to the national grid and mainly serve internal consumer demand.

### 3.3. Current status of collecting and processing livestock waste

Results of the survey of wastewater collection and treatment at 119 farms were presented in Table 3.

**Table 3.** Current status of collecting and processing livestock waste

No	Survey results	Number		Scale (%)
I	No treatment	8		6.73
II	Treatment available	111		93.27
Applied technologies		Efficiency assessment		
		Good	Normal	Not satisfactory / not effective
2.1	Mechanical methods (sedimentation, filtration, separation by mechanical devices, etc.)	0	0	0
2.2	Chemical and physical methods (flocculation, flotation, etc.)	0	0	0
2.3	Biological methods (aerobic, anaerobic, biological clock, etc.)	30	68	13
2.4	Integrated approach	0	0	0
2.5	Total	30	68	13
2.6	Scale (%)	27.03	61.3	11.7

The investigation and study at 119 farms showed that most farms had conducted wastewater treatment systems (93.27%); others were discharged directly into environment without treatment. The amount of wastewater below 50m<sup>3</sup>/day accounted for 97.5% and over 50m<sup>3</sup>/day accounted for 2.5%. In fact, most of the farms had constructed wastewater treatment as biogas tanks, sedimentation tanks, biological ponds. There were 101 units of self-design, construction of wastewater treatment projects accounted for 84.87%; the farms consulted hired designers often were large scales, with a herd of about 600-1500. However, wastewater treatment systems at many farms were in substandard conditions with a limited capacity of

biogas tanks, sedimentation tanks, some farms have built biogas tanks without proper settling tanks and biological ponds. This was due to the lack of funds and public lands for construction, as well as constructing limitation, in which the cause of lacking funding accounted for the highest percentage of 68.25%.

The number of wastewater treatment facilities in good operating conditions was 30 (27%), normal was 68 (accounting for 61.3%), and 13 of them had been damaged (accounting for 11.71%). The level of satisfaction of the wastewater treatment accounted for 72.26%, not satisfactory accounted for 27.74%. The frequency of regular operation of wastewater treatment facilities was 91.6%, occasional not to use was 1.68% and 6.72%. The above results showed that most of the farms had built wastewater treatment facilities and regular operation, but the efficiency was not high, mainly due to degradation, damage without repaired and operational inefficiencies, wastewater was being discharged into the environment with signs of pollution, odor and sediment polluting the surrounding environment. Treated waste water of the farm, mostly was being discharged directly into the drainage system (83/119 units accounted for 69.74%) 15/119 discharged into ponds accounted for 12.6%, and 21/119 discharged to storage ponds, or composting tanks for crop irrigation). The by-products arising from the wastewater treatment process of the farm, mostly were sewage, manure, sludge and odor. Measures to handle the byproducts of the farms were periodically to dredged mud, using biological products such as Haniodine, EM. In addition to 66 units had no sludge and odor treatment, the rest had no radical solutions causing accumulating a large amount of wastewater in the drainage areas of the region and odor emission around. There had been some complaints of the people nearby about the pollution from livestock farms affecting the farmers' lives.

In addition, the survey indicated that some farms were currently applying padding technology to process biological waste. This was padding on the livestock barn. This cushion is made of fiber such as sawdust, rice husks, cassava pulp, bagasse. The litter is spread on the floor after raising will be sprayed onto the surface of a layer of useful microbial enzyme systems. Pig farmers using this technology reduce the cost of clean water to 80%, labor 60% and food 10%, no or very little use of veterinary drugs. The breeding process does not use water to wash the barn; Do not use the water for bathing, washing pets thus limiting the amount of wastewater and manure huge. The advantage of this technology is well applied to the large poultry farms and small-scale livestock. However, the downside of this technology is difficult to apply in the hot dry season, if not proceed bath, cooling for livestock animals, the risk of disease is very high.

The collection and management of solid waste, farms manure waste was collected, utilized containers after using and sold to feed fish; waste from veterinary drugs and other solid wastes was virtually collected, burned and buried on site of 92 units (accounting for 76.47%), rent collection and treatment unit of 10 units (accounting for 8.4%) and 18 units sold to collectors for recycling (accounting for 15.12%).

The analysis of environmental quality of treated wastewater in 04 pig farms (Pig farm in Tho Xuan - JSC Phu Gia; pig breeding farm at Thieu Phu, Thieu Hoa district - JSC Phu Gia agricultural products; 02 farms of Pham Van Tuan and Nguyen Van Xuan at Vinh Tan commune, Vinh Loc district; farm at Tan Phuc, Vinh Phuc, Vinh Loc district) compared to QCVN 40: 2011/BTNMT demonstrated some parameters exceeding standards, namely: TSS exceeding from 1,006 to 5.81; COD exceeding from 1.04 to 9.14 times; BOD<sub>5</sub> exceeding 1.94 to 7.22 times; NH<sub>4</sub> from 1.28 to 27.78 times; total N from 5.76 to 11.85 times; total P from 1.04 to 5.6 times; Coliform exceeding from 4.8 to 15 times.

Thus, the wastewater from the farm after the treatment, the concentration of pollutants in wastewater had decreased, however, the quality of wastewater before discharge into the environment still exceeded standards at many parameters.

Regarding the implementation of the Law on Environmental Protection on farms, Family farms surveyed showed:

82.35% of farm owners were instructed educated through mass media and 13.44% were trained by the local authorities.

75/119 units had no records, environmental procedures as prescribed (accounting for 63%), 44 units had established a commitment for environmental protection (37%).

22/44 units had environmental protection commitment, but not implemented (accounting for 50%); 11/44 units performed occasionally (25%) and 11/44 performed regularly (25%).

Number of units had been checked by authorities on the work of environmental protection was 39/119 accounting for 32.88% (in which 10 units were punished for administrative violations of environmental protection), 80 units accounted for 67.22% were not checked accounting for 67.22%. Investigation showed that 100% units were not yet fully implemented the environmental protection measures in the process of breeding, mainly due to lack of funding, lack of human resources who expertise in the environmental protection and knowledge of waste processes and treatment technologies.

### ***3.4. Current state gelling and process of waste of agriculture from the product of agriculture***

Wastewater generated from trade villages often had very high concentrations of pollution especially for the food processing industry, farming and slaughter. Most villages had not been invested to build wastewater treatment system or had unefficient operation; wastewater without proper treatment were directly discharged into the environment causing pollution of surface and underground water of surrounding areas. For instance, wastewater generated from a village of reeling, weaving at Hong Do, Thieu Do, Thieu Hoa district with high color was discharged directly through the open drain into the environment with no treatment; Village of perishable cargo services (dogs trade) at Thanh Loc, Hau Loc District, currently having 40 households was separated in a designated business area. Wastewater as fertilizer, household food waste was processed through the septic tank; dead dogs were buried;



Sanitary wastewater contained high concentration of pollutants was not collected and treated properly before releasing into the environment; emissions, odor was not treated affecting local people and nearby.

#### **4. Conclusion**

The study showed that farms were more and more rising awareness about environmental protection by investing in waste treatment facilities using various technologies. However, the quality of treated wastewater was not efficient due to old-fashioned technologies. Besides, the operation of these facilities was not conducted regularly or properly, leading to the degradation and damage of system. For agricultural waste, the percentage of districts and towns carried out the collection and treatment of wastewater was very low. This kind of waste is difficult to control due to limiting awareness of most farmers. Sanitary waste was generated in a huge volume and mostly discharged with no treatment. In general, most of areas in Thanh Hoa province do not have a dedicated waste collection and treatment system (except Thanh Hoa city but not yet perfect). The results of this study are to propose suitable treatment solutions.

#### **References**

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